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Sugar Maple: Tree and Bole Weights, Volumes, Centers of Gravity and Logging Residue.

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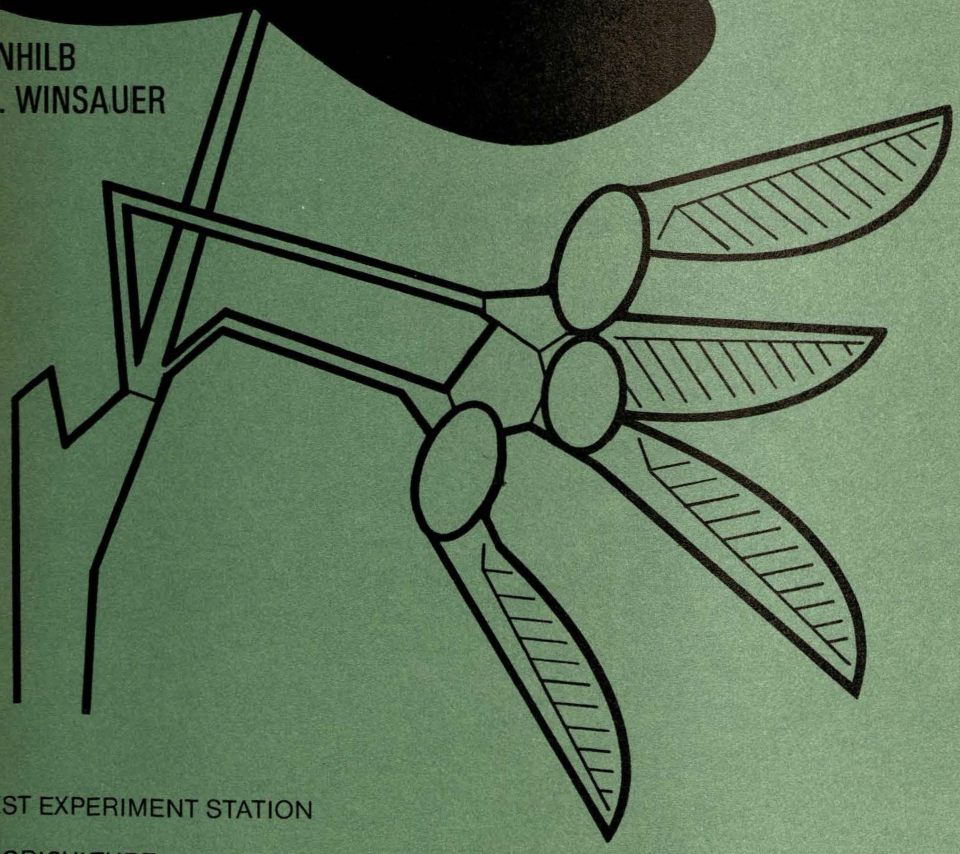

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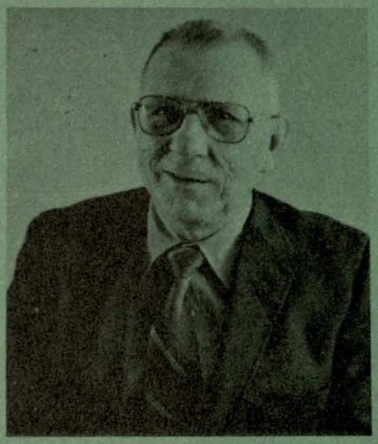
THE AUTHORS



Professor Steinhilb received his B.S. degree in forest management from Michigan Technological University in 1940. His M.S. degree in forest management was obtained from Michigan State University in 1951. From 1940 through 1945, he worked as a forester for the Copper Range Mining Company. From 1946 to the present, with the exception of his 9 months graduate work, he has been employed in the Department of Forestry, Michigan Technological University. He is a registered Forester and a Registered Land Surveyor in the State of Michigan.

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SUGAR MAPLE: TREE AND BOLE WEIGHTS, VOLUMES, CENTERS OF GRAVITY, AND LOGGING RESIDUE

H. M. Steinhilb and Sharon A. Winsauer

A trend toward mechanization of the skidding and loading phases of logging operations has been evident during the past decade. Logging equipment is being developed to handle tree-length boles or entire trees. Designers of such harvesting machines need information on the weight, volume, and center of gravity of trees and boles.

There is also a trend toward more complete utilization of the tree. Present systems tend toward chipping logging residue, and even entire trees, in the woods by mobile machines. Here again, logging equipment design engineers and foresters need estimates of the cubic volume and the weights of logging residue, trees, and boles.

Such information is available for spruce, balsam fir, red pine and aspen.[1/] [2/] But data are also needed for sugar maple and other dense hardwoods that are being increasingly used for wood chips. Because sugar maple is the most prevalent species in the northern hardwood timber type, we recently developed the data reported here.

THE STUDY

The research was conducted in a northern hardwood sawtimber stand located at the Ford Forestry Center, Michigan Technological University, Baraga County, Michigan. Data were collected from 137 sugar maple trees: 58 of pulpwood size and 79 saw log trees. The sample trees ranged from 5 to 24 inches d.b.h. and from 45 to 90 feet in total height.

Field Procedure

Each tree was numbered and its d.b.h. measured to the nearest 0.1-inch. Then it was carefully felled to minimize breakage and loss of limbs. Within 24 hours after felling all portions of each tree were weighed with a weight transducer mounted on a free-swing sling attached to a fork-lift (fig. 1).

Pulpwood trees (trees less than 12 inches d.b.h.) were first weighed whole by suspending them from the weight transducer. A point was marked on each stem directly below the apex of the sling as the center of gravity. Then the tree was limbed and topped to a 4-inch diameter outside the bark; the bole was suspended again, weighed, and its center of gravity marked. Pulpwood tree diameters were measured outside the bark to the nearest 0.1 inch at the stump, at 2 and 4 feet from the butt, and at 8-foot intervals thereafter to a top diameter of 4.0 inches outside the bark. The length of any residual portion of the bole above the last 8-foot section was also measured. Total bole length from the butt to a 4-inch upper diameter point was recorded, together with length of the entire tree.

Felled saw log trees (trees 12 inches d.b.h. or larger) were bucked into saw logs to a 10-inch top according to standard commercial logging practice.[3/] Each of the logs and bole sections and the top of each tree were weighed to the nearest 0.5 pound. Center of gravity was not established for saw log trees.

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[1] *Steinhilb, H. M., and John R. Erickson. 1970. Weights and centers of gravity for quaking aspen trees and boles. USDA For. Serv. Res. Note NC-91, 4 p., illus. North Cent. For. Exp. Stn., St. Paul, Minn.*

[2] *Steinhilb, H. M., and John R. Erickson. 1972. Weights and center of gravity locations for red pine, white spruce, and balsam fir trees and boles. USDA For. Serv. Res. Pap. NC-75, 7 p., illus. North Cent. For. Exp. Stn., St. Paul, Minn.*

[3] *Official grading rules for northern hardwood and softwood logs and tie cuts. Northern Hardwood and Pine Manufacturers Association, Inc., Green Bay, Wisconsin. 1968.*

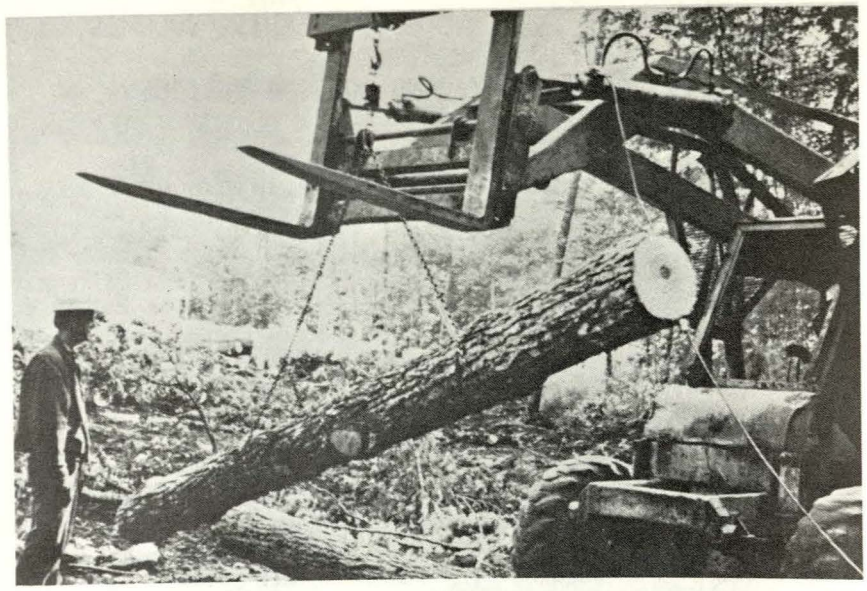

Figure 1.--*Weighing trees and boles.*

Each log, together with any cull sections within the merchantable bole, was scaled with the Scribner Decimal C log rule to obtain both gross and net board foot volume. To determine the cubic foot volume of the bole, diameter outside the bark and bark thickness were measured at both ends of each log. The length, width, and butt diameter of the residual top were recorded.

Analytic Procedure

The cubic foot volume of the boles (including bark) was calculated from taper measurements.

The green weight per cubic foot for each bole was determined by dividing its total green weight by its calculated volume in cubic feet. The weight of the entire tree including the residue was then divided by the weight per cubic foot to obtain the approximate cubic foot volume of the entire tree.

The data were analyzed separately for pulpwood and saw log trees because bole length was defined differently for each class (4-inch top for pulpwood and 10-inch for saw logs) and because center of gravity was measured only for pulpwood trees, and board foot volumes apply only to saw log trees. However, tree weight and tree cubic foot volume measurements were compatible for both classes, so regression equations for tree weight and tree cubic foot volume were obtained for all trees combined.

Both sets of data were analyzed similarly. Scatter plots were made of the desired dependent variables against the various probable independent variables. Promising relations were selected from the scatter plots, studied for homogeneity of variance, and further explored by running various weighted regressions and step-wise regressions. The final equations were selected according to goodness of fit, simplicity, and physical logic; preference was given to those variables that are normally measured in timber inventory or are easily obtainable.

For sawtimber trees, two equations for residue weight per M board feet were selected, one with bole length as the independent variable, the other with d.b.h. Although bole length provided a better fit with a smaller standard error of estimate, the d.b.h. equation is also given for the use of the field forester in those cases where bole length is not taken in the field.

The variance in weight and volume measurements increased as the diameter of the tree increased at a rate of approximately $(d.b.h.)^4$. Therefore, the final equations were run as weighted regressions with a weighting factor of $1/(d.b.h.)^4$ to compensate for nonhomogeneity of tree weights, tree volumes, bole weights, bole volumes, and residue weights.

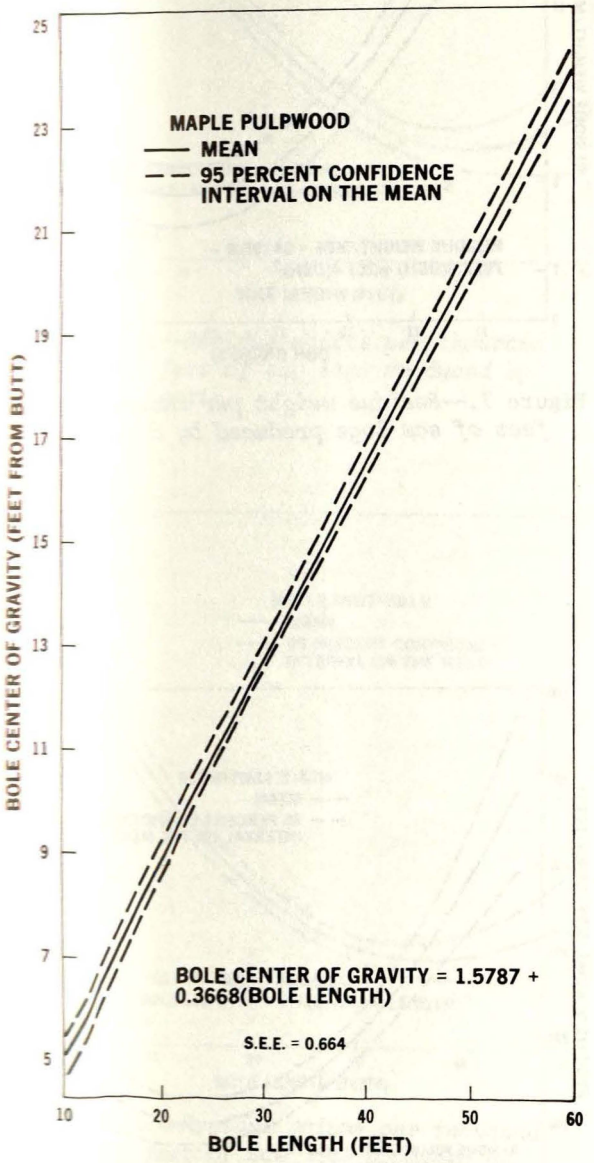

Figure 2.--*Center of gravity of pulpwood boles.*

RESULTS

The equations that resulted from this study were used to develop the tables and charts that follow. Although all this information has various potential uses, we particularly commend table 1 and figures 5, 6, 11, and 12 to foresters and tables 2 and 3 and figures 2 and 3 to equipment designers.

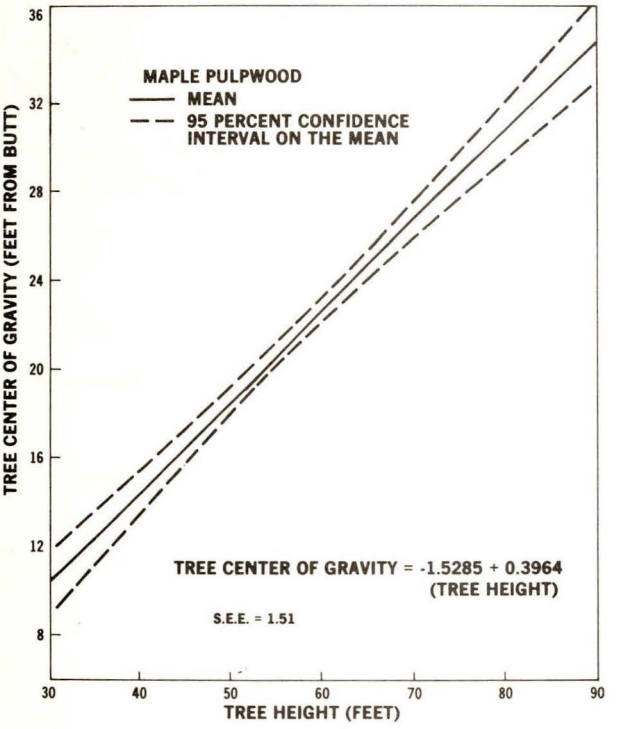

Figure 3.--*Center of gravity of pulpwood trees.*

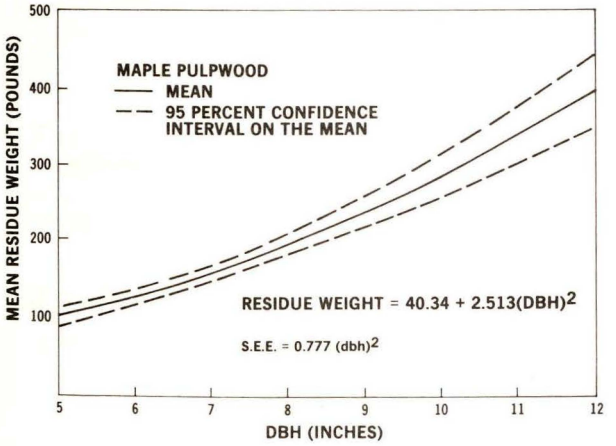

Figure 4.--*Residue weight of pulpwood trees.*

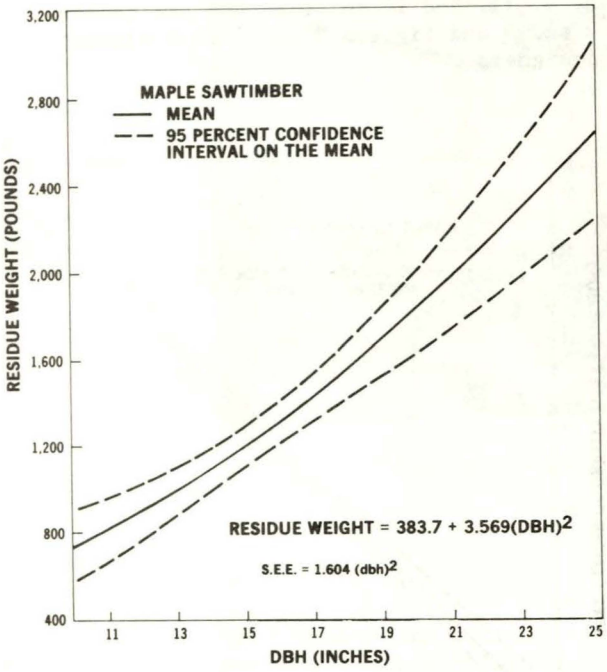

Figure 5.--*Residue weight of sawtimber by d.b.h.*

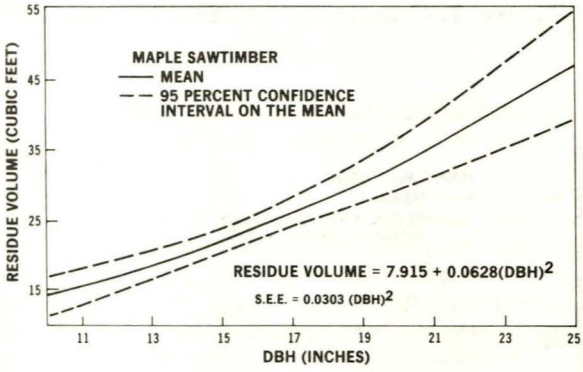

Figure 6.--*Residue volume of sawtimber by d.b.h.*

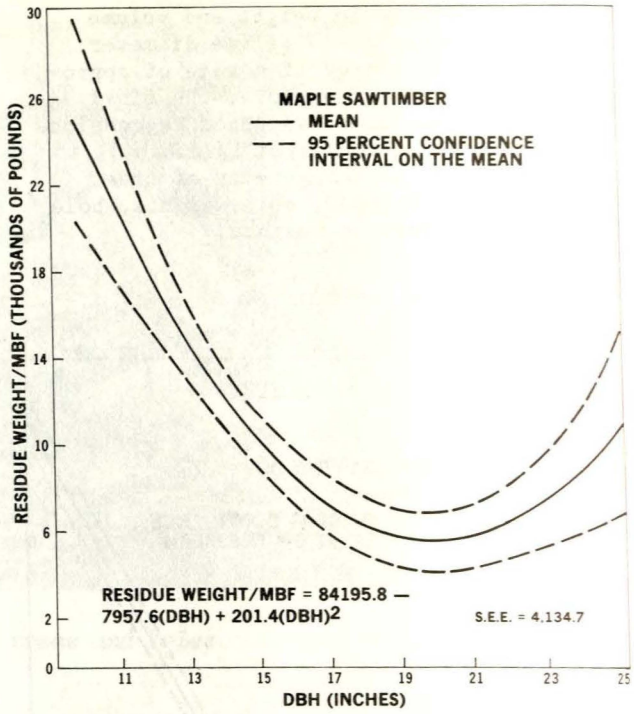

Figure 7.--*Residue weight per thousand board feet of saw logs produced by d.b.h.*

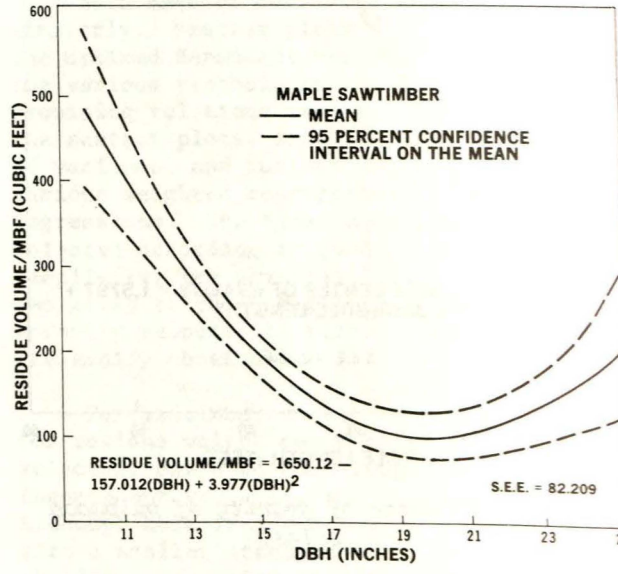

Figure 8.--*Residue volume per thousand board feet of saw logs produced by d.b.h.*

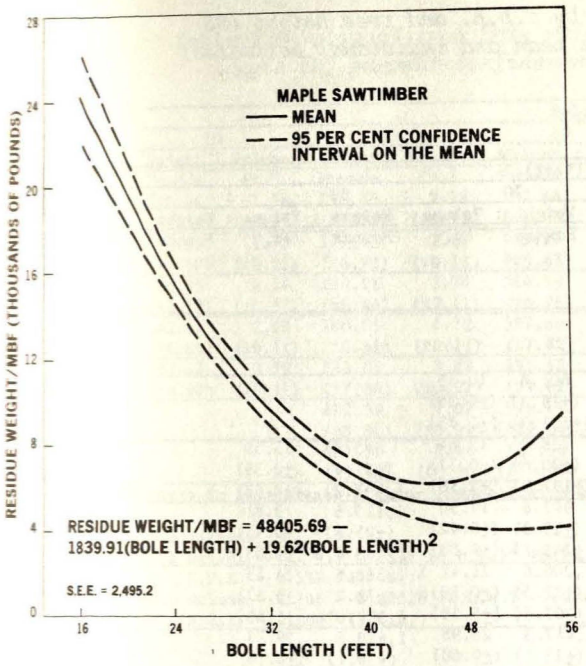
MAPLE SAWTIMBER
MEAN
95 PER CENT CONFIDENCE INTERVAL ON THE MEAN
RESIDUE WEIGHT/MBF = 48405.69 — 1839.91(BOLE LENGTH) + 19.62(BOLE LENGTH)2
S.E.E. = 2,495.2
RESIDUE WEIGHT/MBF (THOUSANDS OF POUNDS)
BOLE LENGTH (FEET)

Figure 9.--*Residue weight per thousand board feet of saw logs produced by bole length.*

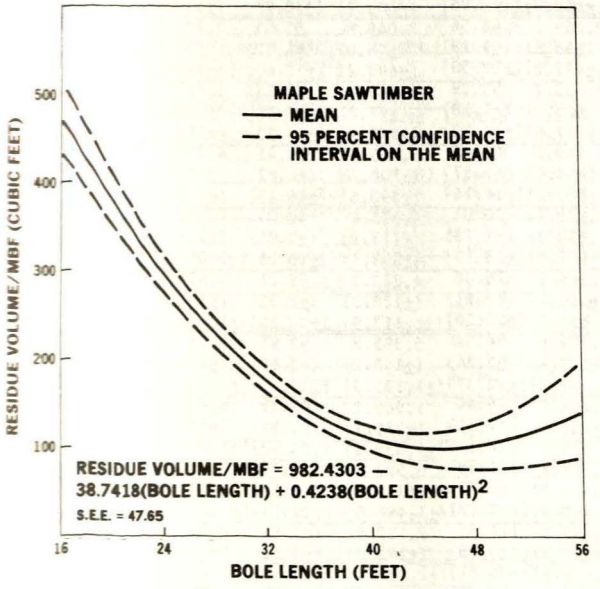
MAPLE SAWTIMBER
MEAN
95 PERCENT CONFIDENCE INTERVAL ON THE MEAN
RESIDUE VOLUME/MBF = 982.4303 — 38.7418(BOLE LENGTH) + 0.4238(BOLE LENGTH)2
S.E.E. = 47.65
RESIDUE VOLUME/MBF (CUBIC FEET)
BOLE LENGTH (FEET)

Figure 10.--*Residue volume per thousand board feet of saw logs produced by bole length.*

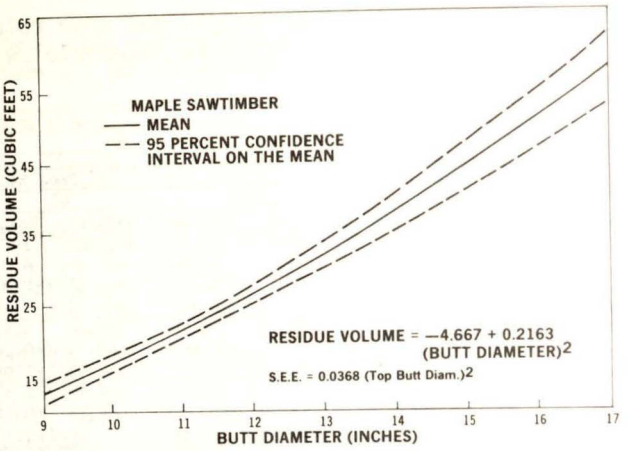
MAPLE SAWTIMBER
MEAN
95 PERCENT CONFIDENCE INTERVAL ON THE MEAN
RESIDUE VOLUME = —4.667 + 0.2163 (BUTT DIAMETER)2
S.E.E. = 0.0368 (Top Butt Diam.)2
RESIDUE VOLUME (CUBIC FEET)
BUTT DIAMETER (INCHES)

Figure 11.--*Residue volume of sawtimber based on butt diameter of the top.*

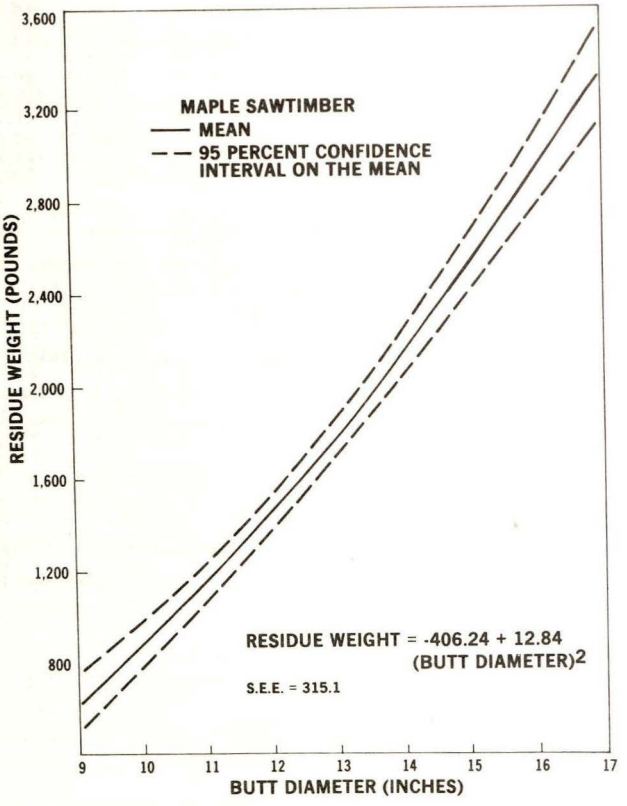

Figure 12.--*Residue weight of sawtimber based on butt diameter of the top.*

Table 1.--*Tree weight and tree volume by d.b.h. and tree height (95 percent confidence intervals on the mean and individual estimates)*

D.b.h.	Tree height (feet)											
	40		50		60		70		80		90	
	Weight	Volume	Weight	Volume	Weight	Volume	Weight	Volume	Weight	Volume	Weight	Volume
	Pounds	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}
5	194.0	2.82	236.0	3.59	277.9	4.37						
	(±21.3)[1]	(±0.39)	(±20.8)	(±0.37)	(±20.3)	(±0.37)						
	[±79.4][2]	[±1.45]	[±79.4]	[±1.44]	[±79.2]	[±1.44]						
6	267.8	4.18	328.2	5.30	388.7	6.42						
	(±20.4)	(±0.37)	(±19.8)	(±0.36)	(±19.5)	(±0.36)						
	[±112.1]	[±2.04]	[±112.0]	[±2.04]	[±112.0]	[±2.04]						
7	355.1	5.80	437.3	7.31	519.5	8.83	601.8	10.35				
	(±19.7)	(±0.40)	(±19.2)	(±0.34)	(±19.0)	(±0.34)	(±19.3)	(±0.35)				
	[±151.3]	[±2.80]	[±151.3]	[±2.75]	[±151.2]	[±2.75]	[±151.3]	[±2.75]				
8	455.8	7.66	563.2	9.64	670.6	11.63	778.0	13.61	885.3	15.59		
	(±19.2)	(±0.35)	(±19.1)	(±0.35)	(±19.6)	(±0.36)	(±20.6)	(±0.37)	(±21.8)	(±0.39)		
	[±196.9]	[±3.58]	[±196.9]	[±3.58]	[±197.0]	[±3.59]	[±197.1]	[±3.58]	[±197.2]	[±3.58]		
9	569.9	9.76	705.8	12.28	841.7	14.79	977.6	17.30	1,113.6	19.81		
	(±19.1)	(±0.34)	(±19.8)	(±0.36)	(±21.3)	(±0.39)	(±23.3)	(±0.42)	(±25.8)	(±0.47)		
	[±248.8]	[±4.52]	[±248.8]	[±4.53]	[±248.9]	[±4.53]	[±249.1]	[±4.53]	[±249.4]	[±4.53]		
10			865.2	15.22	1,033.0	18.32	1,200.8	21.42	1,368.6	24.53		
			(±21.6)	(±0.39)	(±24.3)	(±0.44)	(±27.5)	(±0.50)	(±31.2)	(±0.57)		
			[±307.0]	[±5.58]	[±307.2]	[±5.58]	[±307.5]	[±5.59]	[±307.8]	[±5.60]		
11			1,041.4	18.48	1,244.4	22.23	1,447.5	25.98	1,650.5	29.73		
			(±24.4)	(±0.44)	(±28.4)	(±0.52)	(±33.1)	(±0.60)	(±38.1)	(±0.69)		
			[±371.3]	[±6.75]	[±371.6]	[±6.75]	[±372.0]	[±6.76]	[±372.5]	[±6.77]		
12			1,234.4	22.04	1,496.0	26.51	1,717.6	30.98	1,959.3	35.44		
			(±28.3)	(±0.51)	(±33.8)	(±0.61)	(±39.8)	(±0.73)	(±46.1)	(±0.83)		
			[±441.9]	[±8.03]	[±442.3]	[±8.04]	[±442.7]	[±8.05]	[±443.4]	[±8.06]		
13			1,444.1	25.92	1,727.7	31.16	2,011.3	36.40	2,294.9	41.64	2,578.4	46.88
			(±33.0)	(±0.60)	(±40.0)	(±0.73)	(±47.5)	(±0.86)	(±55.1)	(±1.00)	(±62.9)	(±1.14)
			[±518.6]	[±9.43]	[±519.1]	[±9.43]	[±519.7]	[±9.45]	[±520.5]	[±9.46]	[±521.3]	[±9.47]
14			1,670.6	30.11	1,999.5	36.18	2,328.4	42.26	2,657.3	48.34	2,986.2	54.42
			(±38.5)	(±0.70)	(±47.1)	(±0.85)	(±56.0)	(±1.02)	(±65.1)	(±1.18)	(±74.3)	(±1.35)
			[±601.4]	[±10.94]	[±602.0]	[±10.94]	[±602.8]	[±10.96]	[±603.7]	[±10.97	[±604.8]	[±11.00]
15			1,914.0	34.60	2,291.5	41.58	2,669.1	48.56	3,046.6	55.53	3,424.2	62.51
			(±44.9)	(±0.81)	(±55.0)	(±1.00)	(±65.5)	(±1.19)	(±76.0)	(±1.37)	(±86.7)	(±1.57)
			[±690.5]	[±12.55]	[±691.2]	[±12.56]	[±692.2]	[±12.58]	[±693.2]	[±12.60]	[±694.5]	[±12.62]
16					2,603.6	47.35	3,033.2	55.29	3,462.8	63.22	3,892.3	71.16
					(±63.6)	(±1.16)	(±75.7)	(±1.38)	(±87.8)	(±1.59)	(±100.0)	(±1.81)
					[±786.5]	[±14.30]	[±787.6]	[±14.32]	[±788.9]	[±14.33]	[±790.3]	[±14.36]
17					2,935.9	53.49	3,420.8	62.45	3,905.7	71.41	4,390.7	80.37
					(±72.9)	(±1.32)	(±86.6)	(±1.57)	(±100.4)	(±1.82)	(±114.3)	(±2.07)
					[±888.0]	[±16.14]	[±889.2]	[±16.16]	[±890.6]	[±16.19]	[±892.4]	[±16.22]
18					3,288.2	60.00	3,831.9	70.05	4,375.6	80.09	4,919.3	90.14
					(±82.8)	(±1.51)	(±98.3)	(±1.79)	(±113.9)	(±2.06)	(±129.5)	(±2.35)
					[±995.6]	[±18.10]	[±997.0]	[±18.13]	[±998.7]	[±18.15]	[±1,000.6]	[±18.19]
19					3,660.8	66.88	4,266.5	78.08	4,872.3	89.27	5,478.0	100.47
					(±93.5)	(±1.69)	(±110.7)	(±2.01)	(±128.2)	(±2.32)	(±145.6)	(±2.65)
					[±1,109.5]	[±20.16]	[±1,111.0]	[±20.20]	[±1,112.9]	[±20.23]	[±1,115.0]	[±20.27]
20					4,053.4	74.14	4,724.6	86.54	5,395.8	98.95	6,067.0	111.35
					(±104.6)	(±1.90)	±123.9)	(±2.24)	(±143.2)	(±2.60)	(±162.6)	(±2.95)
					[±1,229.4]	[±22.35]	[±1,231.2]	[±22.37]	[±1,233.3]	[±22.42]	[±1,235.7]	[±22.46]
21					4,446.2	81.77	5,206.2	95.44	5,946.2	109.12	6,686.2	122.80
					(±116.5)	(±2.11)	(±137.8)	(±2.50)	(±159.1)	(±2.89)	(±180.5)	(±3.28)
					[±1,355.5]	[±24.64]	[±1,357.4]	[±24.67]	[±1,359.8]	[±24.72]	[±1,362.5]	[±24.77]
22					4,899.1	89.77	5,711.3	104.78	6,523.4	119.79	7,335.6	134.80
					(±128.9)	(±2.34)	(±152.5)	(±2.77)	(±175.8)	(±3.19)	(±199.3)	(±3.62)
					[±1,487.7]	[±27.05]	[±1,490.0]	[±27.08]	[±1,492.5]	[±27.13]	[±1,495.5]	[±27.19]
23							6,239.8	114.55	7,127.5	130.95	8,015.2	147.35
							(±167.5)	(±3.05)	(±193.3)	(±3.51)	(±219.0)	(±3.97)
							[±1,628.6]	[±29.61]	[±1,631.4]	[±29.65]	[±1,634.7]	[±29.71]
24							6,791.9	124.75	7,758.4	142.61	8,725.0	160.47
							(±183.5)	(±3.33)	(±211.5)	(±3.84)	(±239.6)	(±4.35)
							[±1,773.4]	[±32.24]	[±1,776.5]	[±32.29]	[±1,780.1]	[±32.25]

[1] Numbers in parentheses are confidence interval on the mean.
[2] Numbers in brackets are confidence interval on the individual estimates.

Basic equations:

Tree weight = $26.21 + 0.1678 (\text{d.b.h.})^2 (\text{tree height})$

S.E.E. = $1.56 (\text{d.b.h.})^2$

Tree volume = $-0.283 + 0.0031 (\text{d.b.h.})^2 (\text{tree height})$

S.E.E. = $0.0284 (\text{d.b.h.})^2$

Table 2.--*Pulpwood tree bole weight and bole volume by d.b.h. and bole length (95 percent confidence intervals on the mean)*

D.b.h.	Bole length (feet)											
	10		20		30		40		50		60	
	Weight	Volume	Weight	Volume	Weight	Volume	Weight	Volume	Weight	Volume	Weight	Volume
	Pounds	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}
5	90.74 (±7.82)[1]	1.36 (±0.13)	136.69 (±7.15)	2.18 (±0.12)	182.64 (±6.68)	2.99 (±0.11)						
6	110.96 (±7.50)	1.72 (±0.13)	177.13 (±6.73)	2.89 (±0.11)	243.29 (±6.43)	4.07 (±0.11)	309.46 (±6.70)	5.24 (±0.11)				
7	134.85 (±7.17)	2.14 (±0.12)	224.91 (±6.46)	3.74 (±0.11)	314.98 (±6.76)	5.34 (±0.11)	405.04 (±7.94)	6.94 (±0.14)				
8	162.42 (±6.86)	2.63 (±0.11)	280.05 (±6.51)	4.72 (±0.11)	397.69 (±7.82)	6.81 (±0.13)	515.32 (±10.14)	8.90 (±0.18)	632.95 (±12.95)	10.98 (±0.22)		
9	193.67 (±6.60)	3.19 (±0.11)	342.55 (±7.04)	5.83 (±0.12)	491.42 (±9.61)	8.47 (±0.16)	640.30 (±13.13)	11.11 (±0.22)	789.18 (±17.01)	13.76 (±0.29)		
10			412.39 (±8.06)	7.07 (±0.14)	596.19 (±12.04)	10.33 (±0.20)	779.99 (±16.77)	13.59 (±0.28)	963.79 (±21.77)	16.86 (±0.37)	1,147.59 (±26.89)	20.12 (±0.46)
11			489.59 (±9.58)	8.44 (±0.16)	711.98 (±14.97)	12.39 (±0.26)	934.38 (±20.96)	16.33 (±0.35)	1,156.78 (±27.15)	20.28 (±0.46)	1,379.18 (±33.43)	24.23 (±0.57)

[1] Numbers in parentheses are confidence limits on the mean.

Basic equations:

Bole weight = $44.79 + 0.1838 (\text{d.b.h.})^2$ (bole length)

S.E.E. = $0.514 (\text{d.b.h.})^2$

Bole volume = $0.546 + 0.00326 (\text{d.b.h.})^2$ (bole length)

S.E.E. = $0.0087 (\text{d.b.h.})^2$

Table 3.--*Sawtimber tree bole weight and bole volume by d.b.h. and bole length (95 percent confidence intervals on the mean)*

D.b.h.	Bole length (feet)													
	8		16		24		32		40		48		56	
	Weight	Volume	Weight	Volume	Weight	Volume	Weight	Volume	Weight	Volume	Weight	Volume	Weight	Volume
	Pounds	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}	*Pounds*	*Ft.*^{3}
12	460.9 (±65.5)[1]	8.60 (±1.08)	678.1 (±58.5)	12.57 (±0.96)	895.4 (±52.2)	16.54 (±0.82)	1,112.7 (±46.7)	20.51 (±0.76)	1,329.9 (±42.5)	24.48 (±0.69)				
13	498.6 (±64.3)	9.29 (±1.06)	753.6 (±56.2)	13.95 (±0.92)	1,008.5 (±49.1)	18.61 (±0.81)	1,263.5 (±43.6)	23.27 (±0.72)	1,518.5 (±40.1)	27.93 (±0.66)				
14			835.0 (±53.8)	15.44 (±0.89)	1,130.8 (±46.3)	20.84 (±0.76)	1,426.5 (±41.1)	26.25 (±0.68)	1,722.2 (±39.2)	31.65 (±0.64)	2,017.9 (±41.1)	37.06 (±0.68)		
15			922.5 (±51.4)	17.04 (±0.85)	1,262.0 (±43.7)	23.24 (±0.71)	1,601.5 (±39.5)	29.45 (±0.65)	1,941.0 (±40.3)	35.65 (±0.66)	2,280.5 (±45.6)	41.86 (±0.75)		
16			1,016.1 (±49.0)	18.75 (±0.81)	1,402.3 (±41.4)	25.81 (±0.68)	1,788.6 (±39.3)	32.87 (±0.65)	2,174.9 (±43.6)	39.93 (±0.72)	2,561.1 (±52.5)	46.99 (±0.87)		
17			1,115.7 (±46.7)	20.57 (±0.77)	1,551.7 (±39.9)	28.54 (±0.66)	1,987.8 (±40.8)	36.51 (±0.67)	2,423.8 (±48.9)	44.48 (±0.81)	2,859.8 (±61.4)	52.45 (±1.01)		
18					1,710.1 (±39.2)	31.43 (±0.64)	2,199.0 (±44.0)	40.37 (±0.72)	2,687.8 (±56.1)	49.30 (±0.92)	3,176.7 (±72.1)	58.24 (±1.19)	3,665.5 (±89.8)	67.17 (±1.47)
19					1,877.6 (±39.8)	34.49 (±0.65)	2,422.3 (±48.9)	44.45 (±0.80)	2,967.0 (±65.0)	54.40 (±1.06)	3,511.6 (±84.1)	64.36 (±1.38)	4,056.3 (±104.7)	74.31 (±1.72)
20					2,054.1 (±41.6)	37.72 (±0.68)	2,657.7 (±55.3)	48.75 (±0.91)	3,261.2 (±75.1)	59.78 (±1.23)	3,864.7 (±97.3)	70.81 (±1.60)	4,468.2 (±120.7)	81.84 (±1.98)
21					2,239.7 (±44.7)	41.11 (±0.73)	2,905.1 (±62.9)	53.27 (±1.03)	3,570.5 (±86.3)	65.43 (±1.41)	4,235.9 (±111.7)	77.60 (±1.84)	4,901.3 (±137.9)	89.76 (±2.27)
22					2,434.4 (±49.2)	44.67 (±0.81)	3,164.6 (±71.6)	58.02 (±1.18)	3,894.9 (±98.5)	71.36 (±1.61)	4,625.1 (±126.9)	84.71 (±2.08)	5,355.4 (±156.1)	98.06 (±2.57)
23							3,436.2 (±81.3)	62.98 (±1.34)	4,234.4 (±111.6)	77.57 (±1.83)	5,032.5 (±143.1)	92.17 (±2.37)	5,830.7 (±175.3)	106.74 (±2.88)
24							3,719.9 (±91.9)	68.16 (±1.50)	4,588.9 (±125.5)	84.05 (±2.06)	5,458.0 (±160.2)	99.93 (±2.63)	6,327.1 (±195.5)	115.82 (±3.21)

[1] Numbers in parentheses are confidence interval on the mean.

Basic equations:

Bole weight = $243.59 + 0.1886 (\text{d.b.h.})^2$ (bole length)

S.E.E. = $0.710 (\text{d.b.h.})^2$

Bole volume = $4.630 + 0.00345 (\text{d.b.h.})^2$ (bole length)

S.E.E. = $0.0117 (\text{d.b.h.})^2$

Steinhilb, H. M., and Sharon A. Winsauer.
1976. Sugar maple: tree and bole weights, volumes, centers of gravity, and logging residue. USDA For. Serv. Res. Pap. NC-132, 7 p., illus. North Cent. For. Exp. Stn., St. Paul, Minn.

Presents weights, volumes, centers of gravity, and amount of residue for sugar maple trees and boles. Data may be useful to field foresters and equipment design engineers.

OXFORD: 524.2:526.1:372TL:176.1*Acer saccharum*. KEY WORDS: mechanization, skidding, loading, harvesting.

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